Laboratory Evaluation of Vegetative Debris Removal Techniques within the Circular Holding Tanks at the Tracy Fish Collection Facility

Investigators

Kathleen H. Fenton
Botanist
Fisheries and Wildlife Resources Group
Bureau of Reclamation
Denver, CO 80225
kfenton@usbr.gov

Katherine P. Zehfuss, Ph.D.
Fisheries Biologist
Fisheries and Wildlife Resources Group
Bureau of Reclamation
Denver, CO 80225
kzehfuss@usbr.gov

Connie DeMoyer Svoboda
Hydraulic Engineer
Hydraulic Investigations and Laboratory Services Group
Bureau of Reclamation
Denver, CO 80225
csvoboda@usbr.gov

Summary

The U.S. Bureau of Reclamation (Reclamation) has an active fish collection research program at Tracy Fish Collection Facility (TFCF), California, aimed at improving fish salvage operations. As part of these operations, research towards the improvement in current fish guidance through TFCF, fish salvage, and reintroduction of the salvaged fish into Sacramento-San Joaquin Delta waters are of great importance (R. Silva, personal communication).

Aquatic debris loads entering TFCF have impaired fish salvage efficiency (Boutwell and Sisneros 2006). Debris which includes aquatic plants, woody material, and shells travels through the facility and potentially collects in the cylindrical holding tanks. This debris can affect the guidance of fish to the holding tanks, and may be detrimental to salvaged fish held in the holding tanks. Debris may cause increased injury and mortality to the fish (Karp and Lyons 2008). Studies on debris removal using a traveling screen in the secondary channel designed to remove Chinese Mitten Crabs (*Eriocheir sinensis*), while allowing fish passage through the screen, have been conducted (Boutwell and Sisneros 2006, Boutwell *et al.* 2008, Sisneros *et al*. 2009). The effectiveness of this screen to remove various types of debris appears to be limited, with small debris, less than 101 mm in length, often passing through the traveling screen into the circular holding tanks.

In order to address the issue of debris, TFCF has planned to install a new trashrack cleaning system. In addition, the secondary louver system will be replaced with a Hydrolox traveling screen (Hydrolox Engineered Polymer Screens, Harahan, Louisiana.). It is anticipated that these facility improvements will likely reduce debris loads and composition of debris entering the holding tanks. However, installation of these new systems is not expected until 2011 (B. Mefford, personal communication); therefore, debris accumulation in the holding tanks will remain an issue until the installation of the new facility components is complete. In addition, it is not known if the new systems will adequately reduce debris in the holding tanks even after installation.

This study will focus on the development of a small traveling screen that can be easily lowered into and removed from the circular holding tanks. The screen can be immediately implemented upon completion of the study, and can also be used after the new systems are installed. The debris composition within the circular holding tanks is generally aquatic macrophytes such as Brazilian elodea (*Egeria densa*). The traveling screen would be designed to remove as much floating debris such as aquatic macrophytes and woody materials from the holding tank as possible. Debris removed from the tank would be collected in a trash bin in the holding tank facility.

A physical model of one of the Tracy circular holding tanks was constructed in Reclamation's Hydraulics Laboratory in Denver, Colorado (Portz 2007). In FY 2010, this model will be used in the study to examine the performance of several traveling screen alternatives for debris removal in the holding tanks. Live plants and artificial plants will be used to replicate debris compositions in the field. The most effective debris removal alternative will be selected from model data. In addition, introduced fish tests will be conducted to analyze the effect of the screen on fish survival. This study will be conducted at Reclamation's Hydraulics Laboratory in Denver, Colorado. Future projects may include onsite testing at the Tracy facility.

Problem Statement

Aquatic debris often accumulates within the circular holding tanks and becomes a detriment to salvaged fish both in the holding tanks and later within the fish hauling truck. At times the debris is so dense that it fouls the transport bucket that transfers the fish from the circular holding tank to the hauling truck, as well as the tank outlet to the fish hauling truck. A small, automated debris screen that could be placed within the circular holding tank to remove this debris would be of benefit to the salvaged fish by removing the debris within the holding tanks and thus exposing them to less risk.

Goals and Hypotheses

Goals:

1. Design a small traveling screen that can easily be used to remove common floating debris from the TFCF circular holding tanks without causing harm to the fish.

Hypotheses:

1. Can an efficient traveling screen be designed and implemented within the circular holding tanks?

Ho: the traveling screen does not have an effect on the amount of debris contained in the holding tank, or does not remove a significant amount of debris from the holding tank.
Ha: the traveling screen does have an effect on the amount of debris contained in the holding tank, or does remove a significant amount of debris from the holding tank.

2. Do differing flow velocities and differing amounts of time the traveling screen is used affect its ability to collect debris?
Ho: the length of time the traveling screen is in place does not have an effect on the amount of debris removed from the holding tank.
Ha: the length of time the traveling screen is in place does have an effect on the amount of debris removed from the holding tank.

3. Do differing flow velocities during which the traveling screen is used affect its ability to collect debris?
Ho: the velocities used when the traveling screen is in place does not have an effect on the amount of debris removed from the holding tank.
Ha: the velocities used when the traveling screen is in place does have an effect on the amount of debris removed from the holding tank.

4. Can the traveling screen be implemented without causing detrimental effects to fish held in the holding tank?
Ho: the traveling screen does not have an effect on the survival of fish contained in the holding tank.
Ha: the traveling screen does have an effect on the survival of fish contained in the holding tank.

Materials and Methods

1. Evaluate flow characteristics within the holding tank using a numerical model previously developed by Jim Higgs (Hydraulic Engineer, Hydraulic Investigations and Laboratory Services Group) as reported in Higgs and DeMoyer, 2007. Evaluate field debris swirl characteristics within the holding tank to aid in design and construction of a small traveling screen. This would include positioning of the traveling screen horizontally, vertically and diagonally within the holding tank.

2. Determine the type of debris material to be used in testing. Past TFCF studies and the staff of the facility will be used as resource for determining the most common types and sizes of debris that are observed in the circular holding tanks. Since much of the debris consists of live aquatic plant material, a system will be developed in the Denver Hydraulics lab to maintain or culture a suitable debris mix containing similar plants for use in testing. According to TFCF biologists, Brazilian elodea is the debris of most concern; removal of this plant will be a focus of the research.

3. Juvenile rainbow trout or other suitable fish species will be used to test the screens for physical and traumatic effects on fish. The fish will be obtained from a local fish hatchery. Fish will be assessed for condition prior to use, and after use by holding them for 96-h survival. A control group of fish will also be maintained.

4. Evaluate screens for ease of cleaning after use by developing and testing mechanical methods.

5. Formulate study statistical design with adequate repetitions of each treatment. Treatments include: quantity of debris introduced; flow velocity ranges within tank; length of time screen is in place, and number of fish introduced. Controls will be used to compare against treatment effects. Statistical comparisons among and between treatments and controls will be made using parametric or non-parametric methods, depending on the result data distributions.

Coordination and Collaboration

This study is a collaborative effort with Denver's Hydraulic Investigations and Laboratory Services Group and the Fisheries and Wildlife Resources Group. The Fisheries and Wildlife Resources Group provides a diverse range of expertise including knowledge of aquaculture and fish biology. These two groups will work together in a bio-engineering approach to solving the challenge of designing and implementing a small, automated debris screen for use at the TFCF. We will coordinate with the State pumping facility, Harvey O. Banks Pumping Plant (BMP), to share information resulting from these experiments. Resource agencies will be contacted if traveling screens are recommended for prototype installation. Close coordination with the Biology and Maintenance staff at the TFCF will be maintained in order to fine-tune design and testing of the debris screens.

Endangered Species Concerns

This study will not involve handling or capturing endangered or threatened species. All testing is to be conducted in the physical laboratory model of the Tracy Fish Collection Facility circular holding tank, located at Reclamation's Hydraulics Laboratory at the Technical Service Center in Denver, Colorado.

Dissemination of Results (Deliverables and Outcomes)

The primary deliverable will be a report published in the Tracy Volume Series. A progress report summarizing FY 2010 results for the circular holding tank traveling screen design, construction and testing will be provided for review by late summer of 2010. A draft Tracy Technical Report will be prepared on the finding of these studies for review in preparation of a volume for the Tracy Technical Report Series upon completion of these studies. Findings from this research will also be presented to the Tracy O&M group and Tracy managers, with recommendations and procedures that can be undertaken quickly to improve the existing facilities ability to remove debris within the circular holding tank.

Data collected at the Hydraulics Laboratory will be compiled into graphs and tables. This information will be presented as an assessment of the debris removal effectiveness of the traveling screen, and debris accumulation on the screen and conveyor system. Design and construction recommendations for a traveling screen will be based on evaluation of flow and debris removal of the circular holding tank debris. Any changes in facility operations and future design criteria will be made based upon the data gathered during this study.

Literature Cited

Boutwell, J.E., and D. Sisneros. 2006. *Water born debris removal evaluations using a traveling screen at the Tracy Fish Collection Facility, Tracy, California*, Tracy Fish Collection Facility Studies, Volume 33. U.S. Bureau of Reclamation, Mid-Pacific Region and Denver Technical Service Center.

Boutwell, J. E., D. Sisneros, and D. Craft. 2008. *Standard operating procedures for the debris removal system and traveling screen, Tracy Fish Collection Facility, Tracy, California.* Tracy Fish Collection Facility Studies. Tracy Technical Bulletin 2008-1. U.S. Bureau of Reclamation, Mid-Pacific Region and Denver Technical Service Center.

Higgs, J. and C. DeMoyer. 2007. *Tracy Fish Collection Facility: Numerical model of holding tanks.* Hydraulic Investigations and Laboratory Services Group. Unpublished report.

Karp, C., and J. Lyons. 2008. *Evaluation of fish holding at the Tracy Fish Collection Facility, Tracy, California*. Tracy Fish Collection Facility Studies. Volume 39. U.S. Bureau of Reclamation, Mid-Pacific Region and Denver Technical Service Center.

Portz, D.E. 2007. Fish-holding-associated Stress in Sacramento River Chinook Salmon *(Oncorhynchus tshawytscha)* at South Delta Fish Salvage Operations: *e*ffects on plasma constituents, swimming performance, and predator avoidance. Doctoral Dissertation. University of California, Davis.

Sisneros , D., J.E. Boutwell, and K. Zehfuss. 2009. *Evaluation of Various Mechanical Debris Systems for the Removal of Naturally Incoming Debris at the Tracy Fish Collection Facility, Tracy, California.* Tracy Fish Collection Facility Studies. Volume 43. U.S. Bureau of Reclamation, Mid-Pacific Region and Denver Technical Service Center.